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Surveying and Plotting Method for the River Channel Section Based on the Total Station and CASS

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Abstract

The watercourse section surveying has become more and more important in engineering reconnaissance nowadays, and based on ever urgent social demand for watercourse section surveying, the paper analyzed the subject of how to improve the watercourse section surveying and plotting efficiency. Through studying the opposite side surveying procedure inside the total station and the section surveying and graph plotting method in CASS, an integration of field and office working pattern for section surveying was summarized. The result shows that the working pattern can greatly improve the heretofore less uncultured section surveying and plotting method. Finally it's concluded that the integration of field and office working pattern for section surveying can effectively increase the section surveying and plotting efficiency.

Keywords: section surveying and plotting; opposite side surveying; CASS software; mileage file; earthwork

1. Introduction

Section surveying is an important work content of project reconnaissance. It includes profiles survey (equal to mid-stake survey in concept) and cross-section survey. The traditional section surveying method is undertaken by level, transit stadia and direction set plus poles [1]. While surveying by level results in greater workload because of the restriction by such factors as relief and stadia. As well surveying by transit stadia also has the disadvantages of more observation, greater calculational work, lower precision of elevation and so on for the poor stadia accuracy. Nowadays all kinds of total stations produced generally have opposite side surveying procedure inside. With the widespread total station, there is an

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effective approach to improve surveying efficiency by calling into full play of the total station and existing surveying software.

2. Principle of opposite side surveying

Opposite side surveying is also called indirect surveying，which is used to measure the horizontal distance and difference of elevation between two points. The function is to measure horizontal distances, vertical distances, slide distances and slope [2] between the datum point and target point or the target point and target point.

As Fig.1, Set the total station well over the datum point, meanwhile input the instrument height and the reflecting prism height, then sight the target point 1 to press the Button “Distance Measuring” and the distance and difference of elevation between the datum point and target point 1 can be available, finally they are to be stored. Turn the alidade to sight the target point 2. The instrument will automatically stored the horizontal angle between the direction of the datum point to target point 1 and that of to target point 2, meanwhile the distance and difference of elevation between the datum point and target point 2 can be available. According to the Law of Cosines, the distance and difference of elevation between the target point 1 and 2 can be calculated.

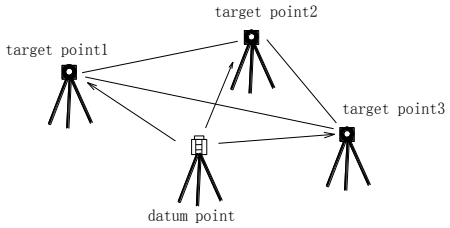

Fig.1.Point classification of opposite side surveying

Generally the total station has the opposite side surveying function divided into such patterns as continuation and radiation. The continuation opposite side surveying can obtain the distance and difference of elevation between the target point in this observation and the previous point, as Fig.2(a). The radiation opposite side surveying can obtain the distance and difference of elevation between the target point in this observation and the first point, as Fig.2(b).

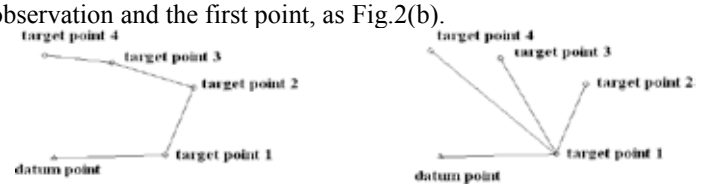

Fig.2.(a)Continuation opposite side surveying;(b)Radiation opposite side surveying

3. Section surveying method based on CASS

CASS, which is topographic and cadastral plotting software based on the technology of AutoCAD platform, is a digital surveying and plotting data collecting system which is explored by South Surveying and Mapping Instrument Company.

The methods of plotting section graphs in CASS include “Under Known Coordinate”, “Under Mileage File” and so on. Because the data obtained by the opposite side surveying with the total station are elevations and horizontal distances of section points, CASS is chosen to plotting section graphs and at

here the plotting method “Under Mileage File” is chosen. The format of the mileage file in CASS is as follows:

BEGIN, Section Mileage: Section Sequence
First Point Mileage，First Point Elevation
Second Point Mileage，Second Point Elevation
……
NEXT
First Point Mileage another term，First Point Elevation
Second Point Mileage another term，Second Point Elevation
……
Next Section
……

4. Combination use of opposite side surveying and CASS section graph plotting

In traditional cross-section surveys, the conventional methods all have lower efficiency. Even though obtaining both the distance and difference of elevation simultaneously with electrical instrument, stations should be frequently moved, so that to let down the efficiency [3]. It is superior for the route cross-section survey to use the radiation opposite side surveying with the function of the total station to obtain the horizontal distance and difference of elevation between two target points, combining with CASS to realize the function of automatically plotting section graph.

4.1. Application of opposite side surveying in watercourse section survey

In the former watercourse cross-section surveying, it always referred to the river-crossing leveling over two banks of the river. So that even if two sides of the mainstream have indivisibility, the river-crossing surveying should also be used, or two levels with tower tapes should be needed, which is difficult to work. While that needs only one station for the total station to undertake opposite side surveying. Set a prism in each side of the mainstream and the watercourse cross-section surveying [4] can be performed continuously and quickly in one lump sum through the opposite side surveying. As Fig.3, find an open control point like C3 near the section to be surveyed, then set the station and input the height of the station and the prism. Start the internal procedure of radiation subsense surveying function in the total station, and then aim at the seventh mid-stake Z_7 to press the button “Distance Measuring”. Take the mid-stake Z_7 as the first target point of the section and then aim at each section point on the left side of the section in sequence to perform the surveying, which the horizontal distance and difference of elevation from each section point to that of the mid-stake can be obtained in the operator interface. After that aim at the right side and obtain the recording data.

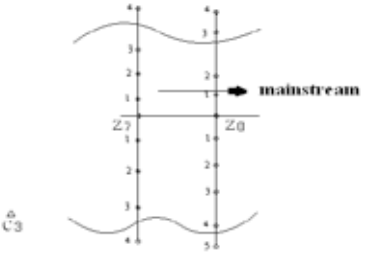

Fig.3.Diagrammatic sketch about section point measuring of the section surveying

If the next section is needed to be surveyed in the following time, the instrument over the station doesn't need to move as the station and the section point are intervisible, so that aim at the mid-stake in the next stake to take it as the first target, then survey the other section points in sequence. In that case, multiple sections can be surveyed by setting only one station, thereby to improve the efficiency greatly.

4.2. Data processing and section graph plotting in CASS

The section surveying data obtained in the field with the opposite side surveying procedure of the total station are compiled to the format of the section mileage files. The compiling environment is in notepad. After compiling the code in notepad, the file is stored as the format of "*.hdm". Then open the CASS software, if only need plotting the section graph, click the menu "Engineer Application" →"Plotting Section Graph"→"Under Mileage File" and choose the corresponding mileage file, so that the section graph can be plotted with a series of settings. If otherwise need calculating the earthwork, click the menu "Engineer Application" →"Section Earthwork Calculation" and choose the designing file of the standard section in the lower menu [5].For example, choose "Free Section". The section graph plotted and the earthwork calculating tables are as Fig.4 and Table 1.

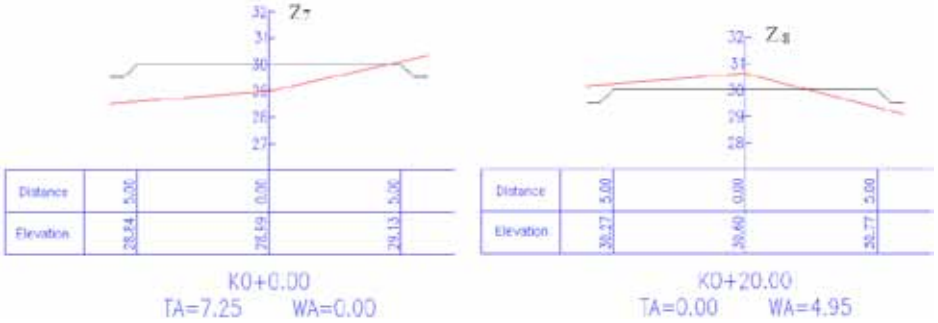

Fig.4.Section graph plotted by CASS

Table 1. Earthwork calculating table plotted by CASS

Mileage	Mid-height (*m*)		Section Area (m^2)		Average Area (m^2)		Distance (*m*)	Total Area (m^2)	
	Fll	Dig	Fll	Dig	Fll	Dig		Fll	Dig
K0+0.00		1.00	72.00	11.00					
					41.23	17.43	20.00	824.60	348.60
K0+20.00	0.60		10.46	23.86					
Sum								824.60	348.60

5. Conclusion

As mentioned above, it can improve the surveying efficiency and solve the practical problems to use the internal procedure of the opposite side surveying in the total station in conjunction with some data processing software on post-surveying like CASS, which realize the integration of field and office working of the section surveying and that will be accomplished with half the effort.

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